Project Summary/Abstract

The discovery of enhanced superconductivity in ultrathin films of FeSe grown on oxide substrates has created a new pathway to high-temperature superconductivity through interface engineering. The successful integration of this discovery into scalable devices and wire technologies requires that we incorporate such interfaces into bulk heterostructures. With this motivation, we propose a research program aimed at 1) identifying new superconducting interfaces in ultrathin film superconductors grown on different families of oxide and semiconducting substrates; 2) developing the capability to simultaneously optimize the critical current densities in the interfacial superconductors by manipulating the interface characteristics; and 3) advance these interfacial platforms towards practical devices by integrating them into bulk semiconductor heterostructures. We will accomplish these goals by combining advanced growth and characterization capabilities with state-of-the-art theoretical modeling. The integration of these interfaces into semiconductor platforms will create unprecedented opportunities to exploit the quantum properties of superconductors. With the existing fabrication capabilities in the semiconducting industry, the success of this proposal will readily facilitate the development of new technologies such as superconducting wires beyond the existing 2G wires.